PROJECT FACT SHEET

CONTRACT TITLE: Laboratory Modeling and Field Development of Borehole Seismic Imaging Techniques Using Wave Field Measurements.

DATE REVIEWED: 07/28/1994 **DATE REVISED:** 07/28/1994

OBJECTIVE: To develop processing, imaging, and interpretation techniques for the use of crosswell seismic data in order to acquire a higher resolution image of the hydrocarbon bearing formation to aid the extraction process.

ID NUMBER: DE-AC22-89BC14478

B & R CODE: AC0530000

CONTRACT PERFORMANCE PERIOD:
09/24/1989 to 03/31/1994
PROGRAM: Supporting Research
RESEARCH AREA: Geoscience

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PROJECT SITE:
Golden, CO

SCHEDULED MILESTONES:

Physical laboratory modeling: Fabricate the models. Perform acoustic measurements. Process model data - modify or write new software. Complete a topical report.	10/91
Field experiment at CSM seismic observatory/Bergen Park, CO Acquire & process 3-component cross-borehole seismic data.	09/92
Field experimental well site work: Acquire and process three-component borehole data at a well site in the Denver-Jilesburg Basin.	09/92
Data Compilation and Final Report.	10/93

FUNDING (1000'S)	DOE	OTHER	CONTRACTOR	TOTAL
PRIOR FISCAL YRS	429	0	0	429
FISCAL YR 1994	0	0	0	0
FUTURE FUNDS	0	0	0	0
TOTAL EST'D FUNDS	429	0	0	429

PROJECT DESCRIPTION: This proposal is directed at the development of processing, imaging, and interpretation of borehole seismic data. A key element is the use of physical acoustic laboratory scale models to generate a digitized model cross-borehole data. These digitized data would be very realistic and contain compressional, shear converted and tube wave modes. These data are easily obtained, and are better data than field acquired data for algorithm development because the model from which the data came is known exactly. Reverse time migration is the imaging technique proposed because of its proven efficiency in other application. After the techniques are developed on known models it is proposed that they be tested using field data. The first test would use shallow hole data near known tunnels, drifts, and known subsurface features at the CSM seismic observatory near Bergen Park, CO. The second test would use production wells in an oil reservoir.

PRESENT STATUS: A no cost extension was signed extending closeout to 10/31/93. A second extension set back the closeout to 3/31/94. The extensive two-component physical model data set, based on the Peoria field reservoir model was successfully acquired. The data have been processed and imaged.

A new advanced state-of-the-art borehole seismic data acquisition system has been acquired for use in the boreholes at Bergen Park, Co. Preliminary data are the best we have seen; and are far superior to the data previously obtained using the old SIE system.

ACCOMPLISHMENTS: The physical model data based on the Peoria field reservoir have been successfully imaged. All four reflected wave modes: compressional-compressional (P-P), shear-shear (S-S) and converted modes, P-S and S-P, were imaged. The image quality is excellent. Perhaps the most important observation made is that excellent images are possible, but they are critically dependent on accurate migration velocities. Small velocity errors cause severe deterioration in the image quality.

The paper titled; "The use of forward and back scattered P-,S-, and converted waves in cross borehole imaging" was a direct result of the DOE sponsored work. It received the prestigious Hagedoorn Award from the European Association of Exploration Geophysicists.

BACKGROUND: One of the most important elements in increasing the predictability of oil and gas recovery, and improving the recovery itself, is a detailed geologic knowledge of the reservoir, and the surrounding sediments. Efforts to understand the production process can only be successful if the effort is made within the context of knowledge of the reservoir itself. This includes knowledge of the media through which the petroleum and natural gas will flow during production.

Borehole seismology - the process of energizing a seismic source in a borehole and measuring the resulting wave field in an adjacent borehole, or at another location in the source borehole - is one of the most promising techniques for obtaining detailed, high-resolution subsurface geologic information. The technique requires significant development before it can be used routinely as an investigative method. Sufficient hardware has been developed to generate data for research purposes. Data taken with this hardware has pointed up the need for processing and interpretation.